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AN EXPERIMENT ANALYSIS ON REPLACEMENT OF WASTE GLASS AS COARSE AGGREGATE OF CONCRETE USING UTM

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Abstract— Waste glass is a type of waste which can not be perished can only be recycled. Due to the ever-growing use of glass items, the amount of waste glass has been expanding tremendously in recent years. Most waste glass has been dumped in designated dump locations. Waste glass should not be buried into the earth because they are not biodegradable and therefore less environmental friendly. Our study on this content examines the possible exercise of persecuted waste glass into coarse total as relief in concrete. The variables then are both the fine and coarse summations cement and water proportion remain constant. The Mix proportion used was 1:1:2(cement fine summations coarse total) with water cement rate 0.45. According to this experimental study, waste glass can be utilised in place of coarse aggregate (up to 30%) with little to no decrease in strength.

Keywords:- Waste glass, Cement, Fine Aggregates, Coarse Aggregates, Compressive Strength, Water.

I. INTRODUCTION

In 2017, the market for recycled glass was predicted to be worth US$3,529.2 million, and by 2025, it is anticipated to be worth US$544.9 million, with a CAGR of 5.7 from 2020 to 2025. (10). Recycled glass is glass that has been processed to create useable goods from waste glass (10). It can be recycled 100 percent of the time without sacrificing quality or purity. A combination of silica, soda pop ash, and additives comparable to CaCO3 are melted at high temperatures to create glass, which then solidifies without

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crystallising when cooled. (7). Up to 95% of the raw equipment can be replaced by recycled glass. Recycling and garbage reduction are crucial waste management practises because they protect the environment and lessen the need for expensive landfill space. One of the most significant categories of external trash, broken glass beverage bottles, has grown to be a significant issue. Millions of tonnes of waste glass are thought to be produced annually as a result of industrialisation and urbanisation globally. Neglected mounts, window grills, window panes, tube lights, light bulbs, electronics, medicine bottles, and liquor bottles are the most typical causes of eyeglasses trash. Due to the significant expense of cleaning and colour sorting, container makers only explicitly seek a tiny fraction of the recovery (10). In the current study, extensive experimental work was conducted to determine whether it would be appropriate to utilise waste glass in concrete, and the following suggestions were proposed:

1. To research the impact of employing waste glass as a partial replacement for natural coarse aggregate on the compressive strength of concrete.
2. To research the cost analysis of concrete made from waste glass.

II. MATERIAL & METHODOLOGY

50 cubes of coarse aggregate and 8 cubes of 0% waste glass were placed for mixing in the laboratory to investigate the effects of using discarded waste glass to partially substitute with natural coarse aggregate on the strength of concrete.. A 150 x 150 x 150 mm concrete cube was casted using nominal mixes in ratios (1:1:2) and compressive strength determination after 7 and 28 days of curing, experiments were done to examine the compressive strength of cubes manufactured with various percentages of glass replacements. was examined. (Water to cement ratio: 0.45).

Cement

Cement is a chemical compound that binds other materials by setting, hardening, and sticking to them. In most cases, rather than being used alone, cement is utilised to bind sand and gravel (aggregate). Concrete is formed from cement blended with sand and gravel, whereas mortar for construction is produced from cement coupled with fine aggregate. Concrete, the most commonly utilized substance in existence, is the second most used resource on the globe behind water. Prism Champion Cement (PPC fly Ash based) of grade 43 is utilised in this experiment. The engineering property of cement is determined in the table 1.

Table 1:- Engineering Properties of Cement used.

S. No.	Properties	Experimental values
1	Normal Consistency	31 %
2	Initial setting time	35 minutes
3	Final setting time	480 minutes
4	Specific gravity of cement	3.1

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Fine Aggregate (Sand)

Concrete made of natural sand or crushed stone needs fine aggregate as a key component. The fine aggregate density and quality significantly affect the hardened properties of the concrete. The concrete or mortar mixture will be more robust, stronger, and less expensive if you chose the fine aggregate based on the grading zone, particle form, surface texture, abrasion and skid resistance, absorption, and surface wetness.(7). The engineering property of fine aggregates are determined in the table 2.

Table 2:- Engineering properties of Fine aggregates used.

S. No.	Properties	Value
1	Specific Gravity	2.65
2	Water Absorption	1.47%
3	Zoning	Zone III
4	Fineness Modulus	3.42%

Coarse Aggregate

Sand, gravel, or crushed stone are examples of coarse aggregates, which are granular and irregular particles used to make concrete. It is possible to get coarse by blasting quarries, physically crushing them, or utilising crushers. Coarse is frequently found in nature. They must be cleaned thoroughly before being used to produce concrete. The concrete is impacted in a number of ways by its strength and angularity. Selecting these aggregates is obviously an essential step (7). Coarse aggregates are frequently referred to as particles with a maximum size of 63mm and large enough to be trapped on a 4.75 mm sieve size. The size of the coarse particles has an impact on the amount of water needed for the concrete mix in addition to the durability and workability of concrete. It also helps in figuring out how much fine aggregate is needed to produce a batch of concrete. Less water and fine aggregate are utilised in concrete mixtures as a result of the fact that the bondable total area of cement, sand, and water decreases with size. The coarse aggregate size affects the cement to water ratio. The engineering property of fine aggregates are determined in the table 3.

Table 3. Engineering Properties of Coarse Aggregates Used.

S.no.	Property	Value	Permissible limits as per IS- values
1	Specific gravity	2.72	2.60 – 2.80
2	Water Absorption	0.86%	>4%
3	Fineness modulus(10	5.96%	5.5 – 8.0
4	Fineness modulus(20	7.13%	5.5 – 8.0

Water

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Clean Pouring and treating are done with potable water. The amount of water needed to achieve the same processability increases with the addition of more degraded trash. Water usage therefore had to be continuously reduced, but because the concrete still contained waste from the demolition, a w/c of 0.45 was employed. [7].

Concrete

The ratio used in the design of the standard concrete mixture is (1:1:2). The standard design of the mixture has a cement content of 360 kg/m3, which satisfies the criterion of 300 kg/m3 to prevent clumping. Concrete was made with good coarse aggregates and naturally occurring river sand from zone III. The max. size of coarse aggregate was 20-10 nm. Sieve analysis was carried out according to IS 383-1970 for both fine aggregate and coarse aggregate [7]. Normally the concrete hardening time is at least 7 days maximum upto 28 days [7].

The progressive hydration of calcium silicates and aluminates is what gives concrete its increased strength. Originally categorised as coarse, angular sand, the sand used in this concrete is now more commonly found with rounded grains. Sharp breaks to the stone are frequent. Concrete's weight parameter fluctuates depending on the kind and quantity of aggregates. [7].

Fig 1: Test set up at REC Azamgarh for compressive strength test of concrete.

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III. RESULT AND DISCUSSION

Results of observations collected from experiments are given in table 4.

Table 4

S.no.	Sample name	Compressive strength(N/mm^2)		% Replacement of Glass
		7days	28days	
1	S1	19.75	24.42	0
2	S2	22.13	25.6	20
3	S3	20.22	25.33	30
4	S4	19.44	24.17	40
5	S5	17.67	23.4	50
6	S6	14.89	20.88	60
7	S7	13.94	14.94	70

The compressive strength increases on averaged around 12.05% over the period of seven days when coarse aggregate is replaced with 20% glass waste, but only by about 4.8% over the duration of 28 days. Additionally, compressive strength typically rises by 2.94% after 7 days and 3.73% after 28 days at the same replacement level when coarse aggregate is substituted with 30% glass waste. After 7 days and 1.02% after 28 days, the amount of waste glass that was used to substitute 40% of the coarse aggregate has decreased by 1.57%.

IV. CONCLUSION

It has been demonstrated that substituting waste glass for coarse aggregate can boost 28-day strength by as much as 30%.

At his 40% to 70% substitution levels for coarse aggregate waste glass, a minor loss in strength is seen.

Waste glass can successfully be utilised in place of coarse particles.

20% is the ideal replacement rate for used glass used as coarse aggregate.

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